RB-8

Eight Channel
Relay Output Card

Blue Chip Technology

User Manual

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Amendment History

Issue Level	Issue Date	Author	Amendment Details
2.0	12/4/95	SH	Major re-write
2.1	28/2/96	EGW	Addition of EMC information to Technical Specification, new front sheet. Errors corrected. Doc ref was RB81040. Filename was ...\RB-8.doc. Part number added
2.2	09/12/97	SEJ	Window front cover and logo. See ECN 97/144.

1.0 INTRODUCTION

The Blue Chip Technology RB-8 board provides the user with eight volt-free contacts for use in general control applications. The relay contacts will handle voltages up to mains potential at low currents or small voltages with a current handling up to 2 Amps.

The board has the facility to power up with various combinations of normally open and normally closed contacts at the output connector. This selection is made by user selectable links. The operating program can read back the status of the relay contacts thereby checking that the relay contact has actually operated as instructed.

The card occupies only one I/O location which is both a read and write address. A write to this location sets the desired relay(s) while a read from this address returns the contact status.

Connection to the card is by screw terminals which facilitates easy connection to the user.

2.0 INSTALLATION

2.1 Setting the Base Address

The base address selection for the card is made by links on the header block JP9. There are ten address line selections on the block ranging from 200 $_{HEX}$ to 001 $_{HEX}$. Address 200 $_{HEX}$ is at the left hand side of the jumper block.

An address line is selected if there is NO link present on the pins. To select an address of 300 $_{HEX}$ for example, all links except 200 H and 100 H should be fitted. The RB-8 card is set to 300 $_{HEX}$ prior to leaving the factory.

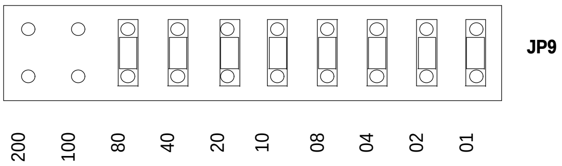

Diagram Showing Address Selector Header

Example shows address 300 Hex

2.2 Setting the Relay Power on State

The RB-8 can be set as to which contacts will power up in the normally open or normally closed state, on an individual contact basis.

This selection is made by the 'handbag' type links on the card. Each link consists of three positions, the middle one of each being the common pin. The pins to either side of the common pin are marked 'NO' and 'NC' (normally open and normally closed). To set a particular contact pair to, say normally open, place a link between the common centre pin and the pin marked 'NO'. Each set of relay contacts should be set to the required state prior to installing the card into the host computer.

3.0 OPERATION

3.1 Selecting a Relay By Software

Switching the relays by software is a matter of writing the correct bit pattern to the base address. The following BASIC example demonstrates this, assuming that the base address is set to 300_{HEX}.

```
10   INPUT"SELECT RELAY TO SWITCH > ", RS
20   IF RS=0 THEN VALUE=0:rem all relays off
30   IF RS=1 THEN VALUE=1:rem bit 0
40   IF RS=2 THEN VALUE=2:rem bit 1
50   IF RS=3 THEN VALUE=4:rem bit 2
60   IF RS=4 THEN VALUE=8:rem bit 3
70   IF RS=5 THEN VALUE=16:rem bit 4
80   IF RS=6 THEN VALUE=32:rem bit 5
90   IF RS=7 THEN VALUE=64:rem bit 6
100  IF RS=8 THEN VALUE=128:rem bit 7
110  OUT (&H300), VALUE:rem send value to switch relay on
150  GOTO 10
```

This simple program allows single relays to be switch on and serves to illustrate the relationship between a single relay and its corresponding bit in the value sent to the card.

Since each relay is controlled by an individual bit within the data sent to the card, any one or any number of relays can be switched on or off simply by writing the correct bit pattern to the board's base address.

3.2 Reading the Contact Status

The RB-8 card permits the user to read back in software the status of each relay contact. This is not a signal generated from a logic holding register, but a logic level produced by a second contact set. This allows a software program to test the physical status of the contacts to test for relay failure.

The relay status is determined by a software read to the board address. The following example illustrates this:

```
120 RSTAT = INP (&H300):rem read relay address
130 RNUM = 255 - RSTAT:determine relay number (active LOW)
140 PRINT"RELAY CURRENTLY OPERATED = ";RNUM;
```

These two programs may be combined to demonstrate a relay "Set" and confirmatory "Read" operation.

4.0 USER CONNECTIONS

The user connections to the card are made by pins on the connector (or optional screw terminals) at the rear of the board. These terminals may carry voltages up to mains potential, therefore care must be exercised. Using voltages as high as this on the rear of a PC card is not generally to be recommended.

Pin	Contact
1	RLA 8a
2	RLA 8b
3	RLA 7a
4	RLA 7b
5	RLA 6a
6	RLA 6b
7	RLA 5a
8	RLA 5b
9	RLA 4a
10	RLA 4b
11	RLA 3a
12	RLA 3b
13	RLA 2a
14	RLA 2b
15	RLA 1a
16	RLA 1b

Connection Pinouts

Note: Pin 1 is left hand most connection nearest to the edge connector.

5.0 SPECIFICATION

Eight channel relay contact closure/opening upon software command. Contact status read back, operating on actual contacts not control bits.

Contacts individually selectable for Normally Open (NO) or Normally Closed (NC) state at power up.

5.1 Technical

Relay Contact Specifications	(See graph on following page)
Maximum Contact Carry Current	3 Amp
Maximum Switching Current	2 Amp DC, 1 Amp AC
Maximum Recommended Voltage	125 Volts DC, 100 Volts AC
Maximum Contact Power Rating	60 VA / 600 Watts
Contact Bounce Time	Make 0.5 mSec Break 0.5 mSec
Contact Response Time	Make 5 mSec Break 5 mSec
Contact Resistance	50 mOhm
Contact Life (operations)	Electrical 500,000 At Full Load Mechanical 50,000,000
Power Consumption	1.8 Watts maximum (All Relays On)
Address Overhead (Read/Write)	1 Address
Connections To Card	16 Way Male Connector (Additional Plug-In Screw Connector Available)

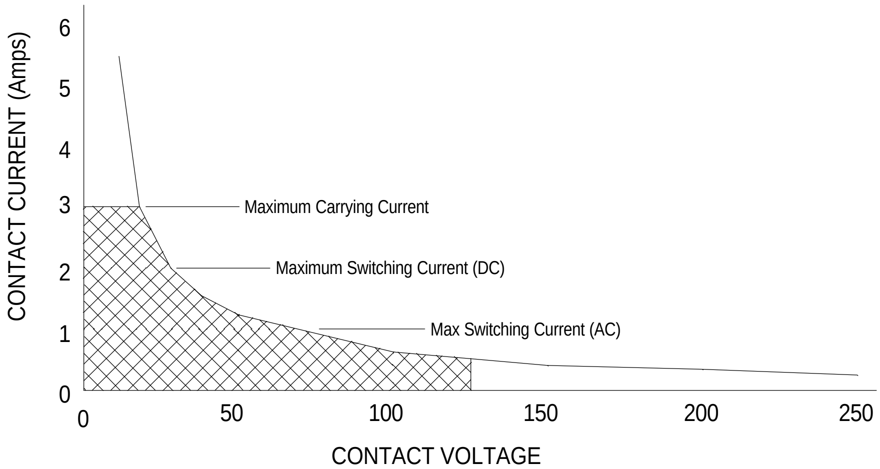

Diagram Showing Relay Contact Rating

Hatched area indicates recommended maxima.

5.2 ELECTROMAGNETIC COMPATIBILITY (EMC)

This product meets the requirements of the European EMC Directive (89/336/EEC) and is eligible to bear the CE mark.

It has been assessed operating in a Blue Chip Technology Icon industrial PC. However, because the board can be installed in a variety of computers, certain conditions have to be applied to ensure that the compatibility is maintained. It meets the requirements for an industrial environment (Class A product) subject to those conditions.

- The board must be installed in a computer system which provides screening suitable for the industrial environment.
- Any recommendations made by the computer system manufacturer/supplier must be complied with regarding earthing and the installation of boards.
- The board must be installed with the backplate securely screwed to the chassis of the computer to ensure good metal-to-metal (i.e. earth) contact.
- Most EMC problems are caused by the external cabling to boards. It is important that any external cabling to the board is totally screened, and that the screen of the cable connects to earth at both ends of the cable. It is recommended that round screened cables with a braided wire screen are used in preference to those with a foil screen and drain wire. With the terminal block connection to the card there is no space available for an earth point on the board mounting bracket. It is recommended that the screen be connected to the metal body of the PC (and hence earth) by the shortest possible “pig-tail”. The BCT Icon chassis has these available adjacent to the expansion area. Unscreened cable will not be adequate unless it is contained wholly within the cabinetry housing the industrial PC and carefully routed.

- To ensure that the board meets the industrial radiated field immunity of 10 V/metre, the cable should also be fitted with a ferrite clamp on the external cable as close possible to the connector. The preferred type is the Chomerics clip-on style, type H8FE-1004-AS.

- Ensure that the screen of the external cable is bonded to a good RF earth at the remote end of the cable.

Failure to observe these recommendations may invalidate the EMC compliance.

> Warning
> This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

EMC Specification

A Blue Chip Technology Icon industrial PC fitted with this card meets the following specification:

Emissions	EN 55022:1995	
	Radiated	Class A
	Conducted	Class A & B
Immunity	pr EN 50082-2:1991 incorporating:	
	Electrostatic Discharge	IEC 801-2:1984 Performance Criteria A
	Radio Frequency Susceptibility	IEC 801-3:1984 Performance Criteria A
	Fast Burst Transients	IEC 801-4:1988 Performance Criteria A

APPENDICES

Appendix A - NUMBERING SYSTEMS

Binary and Hexadecimal Numbers

The normal numbering system is termed DECIMAL because there are ten possible digits (0 to 9) in any single column of numbers. Decimal numbers are also referred to as numbers having a Base 10. When counting, the numbers increment in the units column from 0 up to 9. The next increment resets the units column to 0 and carries over 1 into the next column. This 1 indicates that there has been a full ten (the base number) counts in the units column. The second column is therefore termed the "tens" column.

It is more convenient when programming to use a number system that provides a clearer picture of the hardware at an operational or register level. The two most common number systems used are BINARY and HEXADECIMAL. These two systems provide an alternative representation to decimal numbers.

For a binary number there are only 2 possible values (0 or 1) and as a result binary numbering is often known as Base 2. When counting in binary numbers, the number increments the units column from 0 to 1. At the next increment the units column is reset to 0 and 1 is carried over to the next column. This column indicates that a full two counts have occurred in the units column. Now the second column is termed the "twos" column.

Hexadecimal numbers may have 16 values (0 to 9 followed by the letters A to F). It is also known as a system with the Base 16. With this counting system the units increment from 0 to 9 as with the decimal system, but at the next count the units column increments from 9 to A and then B, C and so on up to F. After F the units column resets to 0 and the next column increments from 0 to 1. This 1 indicates that sixteen counts have occurred in the units column. The second column is termed the "sixteen's" column.

The following table shows how the three systems indicate successive numbers

Decimal
Base 10

0	0
0	1
0	2
0	3
0	4
0	5
0	6
0	7
0	8
0	9
1	0
1	1
1	2
1	3
1	4
1	5
1	6
1	7
1	8
1	9
2	0

Binary
Base 2

0	0	0	0	0
0	0	0	0	1
0	0	0	1	0
0	0	0	1	1
0	0	1	0	0
0	0	1	0	1
0	0	1	1	0
0	0	1	1	1
0	1	0	0	0
0	1	0	0	1
0	1	0	1	0
0	1	0	1	1
0	1	1	0	0
0	1	1	0	1
0	1	1	1	0
0	1	1	1	1
1	0	0	0	0
1	0	0	0	1
1	0	0	1	0
1	0	0	1	1
1	0	1	0	0

Hexadecimal
Base 16

0	0
0	1
0	2
0	3
0	4
0	5
0	6
0	7
0	8
0	9
0	A
0	B
0	C
0	D
0	E
0	F
1	0
1	1
1	2
1	3
1	4

Notice how the next higher column does not increment until the lesser one to its right has overflowed.

Binary representation is ideally suited where a visual representation of a computer register or data is needed. Each column is termed a BIT (from **B**inary dig**IT**). Only five Bits are shown in the above table. With larger numbers, more Bits are required. Normally Bits are arranged in groups of eight termed BYTES. By definition there are 8 BITS per BYTE. Each Bit (or column) has a value. In the binary table above the rightmost or least significant column each digit has a value of 1. Each digit in the next column has a value of 2, the next 4, then 8 and so on.
The following diagram illustrates this.

BIT No	7	6	5	4	3	2	1	0
DECIMAL VALUE	128	64	32	16	8	4	2	1

To determine the decimal value of a binary pattern, add up the decimal number of each column containing a binary “1”.

BIT No	7	6	5	4	3	2	1	0
DECIMAL VALUE	128	64	32	16	8	4	2	1
BINARY NUMBER	1	1	0	0	0	1	1	0

The above example shows the binary pattern that is equivalent to 198_{Decimal}.

The binary string defining a Byte can be unwieldy. To make it less error prone, the 8 bits forming a byte are divided into two groups of 4 bits, known as NIBBLES. With four bits there are 16 possible numeric combinations (including zero). A convenient method of representing each nibble is to use the hexadecimal base 16 system.

When converting binary to hex, the byte is divided into nibbles each represented by a single hex digit. This technique is applied to the selection of the base address for the circuit board. The following diagram illustrates the construction of a hex number.

BIT No	7	6	5	4	3	2	1	0
NIBBLE VALUE	8	4	2	1	8	4	2	1
BINARY NUMBER	1	1	0	0	0	1	1	0

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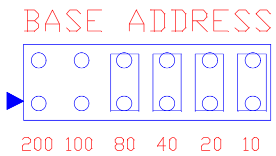
HEXADECIMAL: C 6

Hexadecimal upper nibble = (1 x 8) + (1 x 4) + (0 x 2) + (0 x 1) = 12
lower nibble = (0 x 8) + (1 x 4) + (1 x 2) + (0 x 1) = 6

The resulting value is $C6_{\text{Hex}}$, since 12_{Decimal} equals C_{Hex}.

Base Address Selection

Each column can be physically represented on the board by a pair of pins. In practice, the boards cover a range of addresses (usually 16 $_{\text{Decimal}}$). Therefore the low order four bits are not included, but two higher order bits are added. This gives an address range of 0 to 3F0 $_{\text{Hex}}$. The following diagram shows a typical set of pins.



Here a link is fitted to denote a binary or logic "0", or left open to indicate a binary or logic "1". The example shows a base address setting of 300 $_{\text{Hex}}$.

APPENDIX B - PC MAPS

PC/XT/AT I/O Address Map

Address	Allocated to:
000-01F	DMA Controller 1 (8237A-5)
020-03F	Interrupt Controller 1 (8259A)
040-05F	Timer (8254)
060-06F	Keyboard Controller (8742) Control Port B
070-07F	RTC and CMOS RAM, NMI Mask (Write)
080-09F	DMA Page Register (Memory Mapper)
0A0-0BF	Interrupt Controller 2 (8259)
0F0	Clear NPX (80287) Busy
0F1	Reset NPX (80287)
0F8-0FF	Numeric Processor Extension (80287)
1F0-1F8	Hard Disk Drive Controller
200-207	Reserved
278-27F	Reserved for Parallel Printer Port 2
2F8-2FF	Reserved for Serial Port 2
300-31F	Reserved
360-36F	Reserved
378-37F	Parallel Printer Port 1
380-38F	Reserved for SDLC Communications, Bisync 2
3A0-3AF	Reserved for Bisync 1
3B0-3BF	Reserved
3C0-3CF	Reserved
3D0-3DF	Display Controller
3F0-3F7	Diskette Drive Controller
3F8-3FF	Serial Port 1

PC/XT Interrupt Map

Number	Allocated to:
NMI	Parity
0	Timer
1	Keyboard
2	Reserved
3	Asynchronous Communications (Secondary) SDLC Communications
4	Asynchronous Communications (Primary) SDLC Communications
5	Fixed Disk
6	Diskette
7	Parallel Printer

PC/AT Interrupt Map

Level		Allocated to:
CPU NMI		Parity or I/O Channel Check
CTLR 1	CTLR 2	(Interrupt Controllers)
IRQ 0		Timer Output 0
IRQ 1		Keyboard (Output Buffer Full)
IRQ 2		Interrupt from CTLR 2
	IRQ 8	Real-time Clock Interrupt
	IRQ 9	S/w Redirected to INT 0AH (IRQ 2)
	IRQ 10	Reserved
	IRQ 11	Reserved
	IRQ 12	Reserved
	IRQ 13	Co-processor
	IRQ 14	Fixed Disk Controller
	IRQ 15	Reserved
IRQ 3		Serial Port 2
IRQ 4		Serial Port 1
IRQ 5		Parallel Port 2
IRQ 6		Diskette Controller
IRQ 7		Parallel Port 1

DMA Channels

0	Memory Refresh
1	Spare
2	Floppy Disk Drive
3	Spare